Krimmelet al. reply

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Krimmel *et al.* Reply: In a recent Letter, we have reported on a dramatic change of the magnetic response in LiV_2O_4 as determined by quasielastic neutron scattering [1]. We have interpreted these results as evidence for a possible transition from a low temperature heavy fermionlike state to a weak ferromagnetic metallic state at elevated temperatures. In his Comment, Murani [2] calls these conclusions into question. First, Murani emphasizes that in systems displaying significant Q dependence, a Q analysis using mean scattering angles is not justified. Indeed, performing a fully correct analysis employing a constant Q mapping may result in slight modifications. We are aware that the Q dependence may be complicated. The important statement anyway is that the Q dependence changes in a qualitative way around $T \approx 50$ K. We also want to stress that spin fluctuation theory predicts a linear Q dependence of the spectral width for weak ferromagnetic metals [3]. Our interpretation is in fact supported by the Q dependence of the energy integrated scattering cross section, that can be fitted as predicted for an itinerant electron metal [4], according to $\int S(Q,\omega)\, d\omega \propto (\chi_0^{-1} + cQ^2)^{-1}$ with χ_0 and c as fitting constants. It should be noted that such a behavior is much less surprising for a transition metal oxide than the low temperature heavy fermionlike state. Furthermore, we do not think that a Q dependence of the integrated quasielastic intensity has to be inconsistent with an almost Q independent line width at low temperatures. Though there are models predicting $\chi(Q)\Gamma(Q) = \text{const}$ [5], it has been shown by Rossat-Mignot *et al.* that these theoretical predictions are too simple to explain the neutron scattering results of heavy fermion systems [6]. Murani's statement, that a Q independent line width is physically inconsistent with strongly correlated electron behavior for any magnetic system is correct only in an absolute strict sense. We would like to recall some experimental findings of a few archetypical heavy fermion systems. In the case of $CeCu_2Si_2$, a polarized neutron scattering study on polycrystalline samples was unable to detect any Q dependence of the spectral width [7]. For $CeCu_6$ only a single crystalline study established a Q dependence of the line width, changing by less than a factor of 2 [8]. This Q dependence was insufficient to be detected on polycrystalline samples [9]. In the case of UPt_3 again only single crystalline material revealed a weak Q dependence of the spectral width [10], whereas the intensity changed considerably on momentum transfer. In the present case of LiV_2O_4 we observe a change of the linewidth upon temperature by a factor of 3 on polycrystalline samples. It is this qualitative nature of our results that justifies publication in Physical Review Letters.

Concerning the comparison of NMR and neutron scattering results, we explicitly quote the restricting conditions in our Letter. Of course, the comparison between $S(Q,\omega_0)$ and $1/T_1$ is strictly valid only for single-ion behavior. The comparison between quasielastic neutron scattering and NMR results under these restricting assumptions leads to reasonable agreement in archetypical 1:2:2 f-electron heavy fermion systems [11] (among other compounds). Concerning the additional possible influence of the Q dependence of the susceptibility onto the spin-lattice relaxation, again it is hard to speculate about the anisotropy of χ'' in powder samples. Therefore the disagreement between NMR and neutron scattering results in the present case of LiV_2O_4 is significant.

The comment by Murani is valuable concerning technical aspects of our Letter. *We insist that the results and physical conclusions remain unchanged, as long as no pronounced Q-dependence at low temperatures has been established.*

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